Space Weather Technical Forecast

Issued on Sunday, 21 November 2021 at 00:37 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight Chance of G1 at first. Chance of ensuing Active electron fluence into new week.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the last 24 hours, with no significant X-ray flare activity observed at GOES 16. There are two active sunspot regions on the visible disc: AR2896 and AR2897, which are both small and stable unipolar Hsx/Alpha regions.

A large but faint filament gradually disappeared from the northern solar hemisphere meridian during the UTC afternoon on AIA304 imagery, also very faintly visible on ground-based El Teide H-Alpha imagery roughly between 20/1200 and 1600UTC. There is not yet any evidence of any ICME on coronagraph imagery.

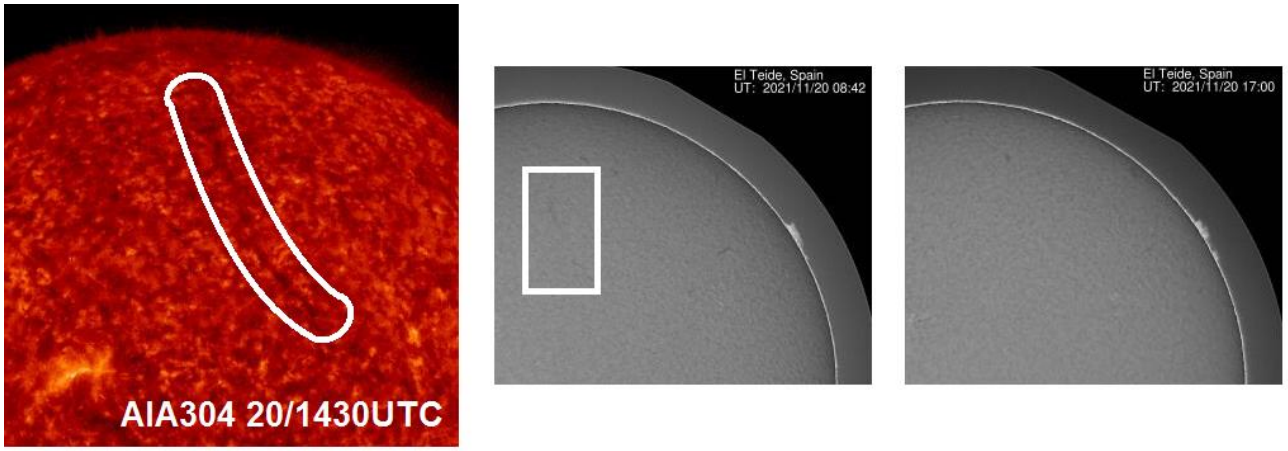

Figure 0: AIA304 and El Teide H-alpha imagery of possible disappearing filament observed in the period. There is not yet any confirmed ejecta on coronagraphs for this event.

In addition to this event, there was a possible prominence eruption from narrowly behind the northeastern limb around 20/0600UTC, with the ejecta not Earthbound. Finally, a CME became visible on Lasco and STEREO A COR2 during the UTC evening. The attribution for this event is not yet certain, however it appears as a partial halo on COR2 and emerges rightwards on Lasco, implying the emission location may be far-sided and diametrically opposite STEREO's current position. Should thoughts on this change, updates will follow in future guidance.

Regarding other noteworthy features, there are currently two large filaments in the southeastern quadrant, however these appear to be stable at the time of writing. No Earth-directed Coronal Mass Ejections (CMEs) have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, increased as a result of connection to a negative polarity coronal hole in the UTC of Saturday 20

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November. This is thought to be the influence of coronal hole 20, and as a result the phi angle was resolutely negative (towards the sun) throughout. The solar wind speed rose from 410km/s to reach 580km/s by the UTC evening, with much of this rise occurring as a near-step change shortly before 20/0600UTC. The solar wind density, meanwhile, showed a flat trend near 10ppcc, while the IMF peaked near 10nT with a north-south component varying between -7 and +6nT.

The result of the above solar wind measures was nevertheless provisionally mainly Quiet, with Kp peaking at a provisional Unsettled '3o' in the 15-18UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained at Background levels.

The high energy electron flux (greater than 2 MeV) was predominantly at Moderate levels, peaking at 587pfu at 20/1510UTC. The associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), with a near-level trend, recording 1.69e7 integrated pfu at 21/0001 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Very Low, with a daily Slight Chance of C-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the current four-day forecast.

Earth's interaction with the current fast wind is likely to be the peak of activity for the period, with Unsettled intervals Likely, as well as a now reduced Slight Chance of G1 should any prolonged Bz materialise, although this should become less likely with time. The new working week UTC should see a resumption of a slow solar wind environment, with geomagnetic activity correspondingly falling to Quiet.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels.

The high energy electron flux (greater than 2 MeV) is expected to to rise as geomagnetic activity wanes from the current fast wind. The magnitude of this rise is uncertain, however diurnal oscillations peaking in High flux are Likely, while the 24-hour integrated fluence should carry a Chance of breaching Active early in the period, before very gradually ebbing away thereafter.

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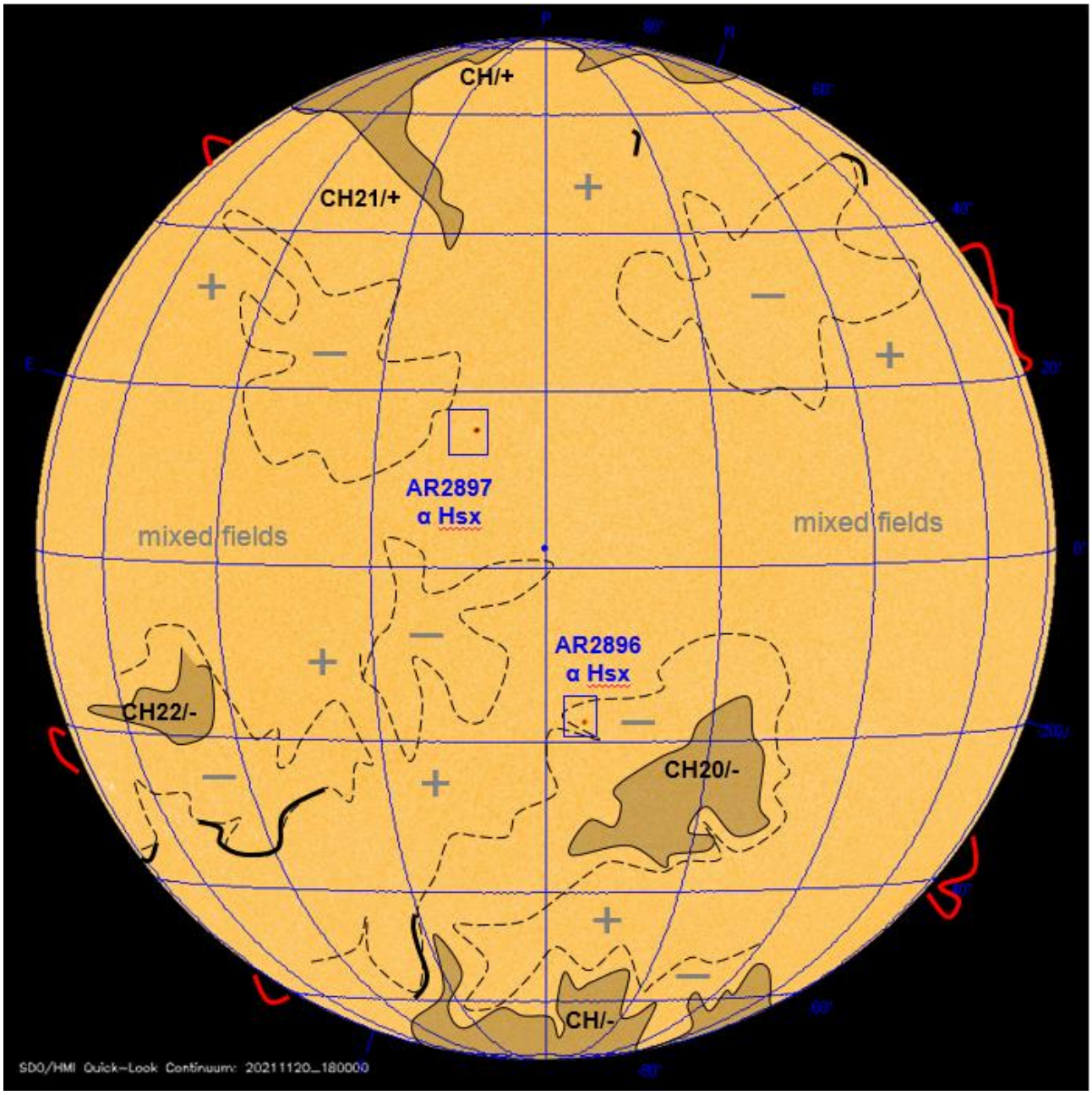
Figure 1. Solar Analysis Valid 20/1800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs that feature in the current forecast.

The current fast wind from coronal hole 20 is the sole confirmed driver of enhanced geomagnetic activity expected in the coming four days, with activity likely to peak during day one, Sunday 21 November. At the time of writing, this feature has been rather more muted than expected, with speeds nearer 550 than 700 (hinted at in a noisy STEREO A PLASTIC solar wind speed trace), and the risk of G1 has been (significantly) lowered accordingly. Even this will rely on developing a prolonged period of southward Bz, with the current character being rather erratic between co- and anti-aligned with Earth's field.

This feature manifested as a bimodal peak at STEREO A, the peaks separated by roughly 24 hours, with this being the reason for the gradual decline in G1 risk over the first 36 hours or so - i.e. the Slight Chance of G1 is preserved should the speed rise once again, before more decidedly falling towards midweek.

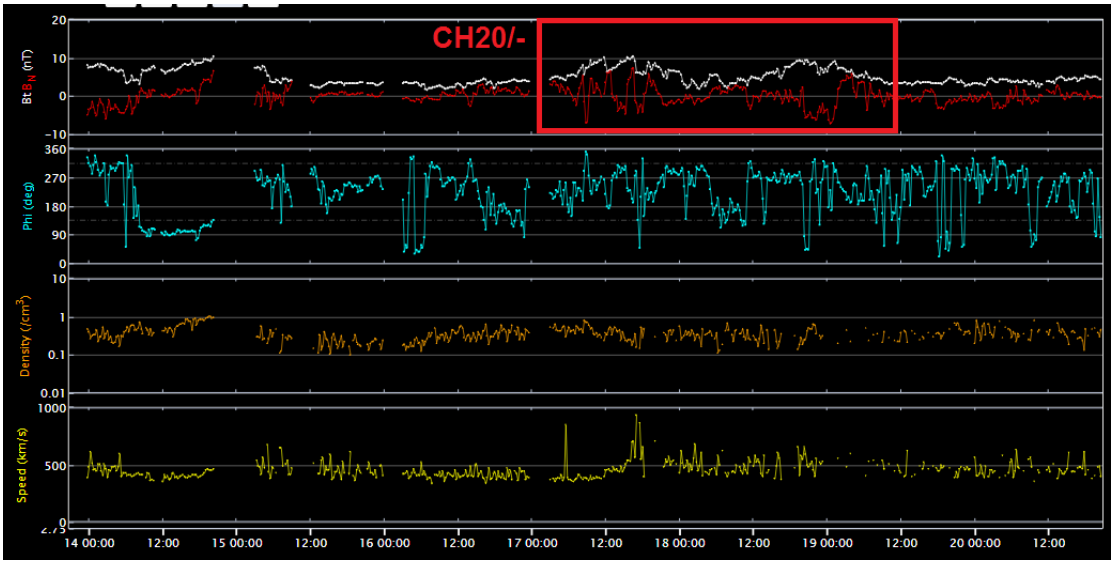

Figure 2: STEREO A MAG and PLASTIC trace for the past 7 days, showing possible twin peaks from the current fast wind feature seen at Earth. This is the rationale for the prolonged Slight Chance of G1 in the forecast.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

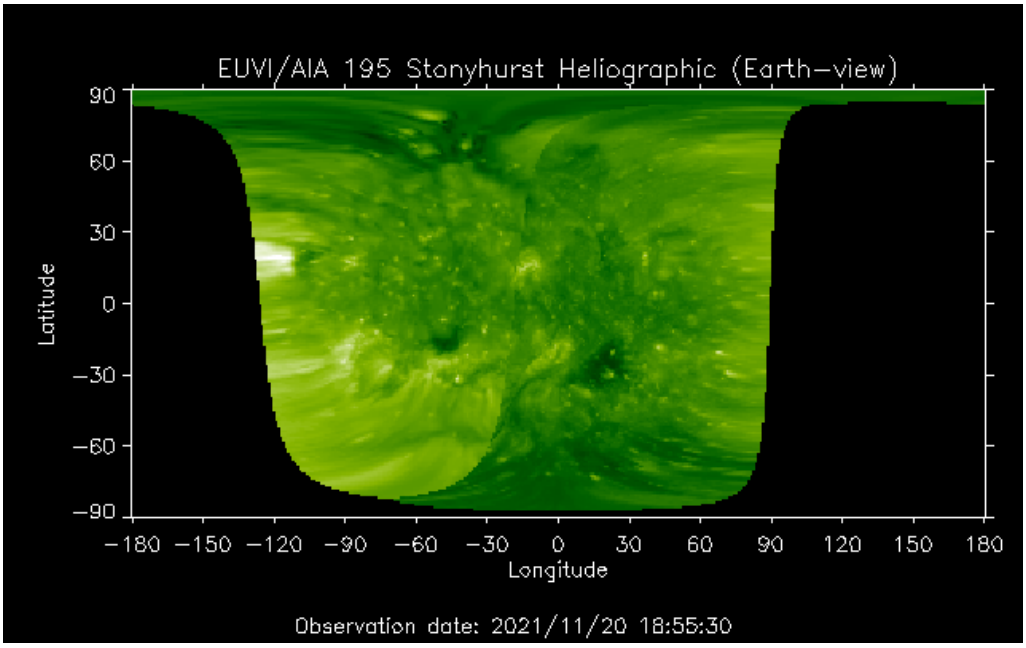
Radio Blackouts - X-Ray Flares:

There are currently two active sunspot regions on the visible disc; AR2896 and AR2897. Both are simple, stable and unipolar spots.

Neither region will rotate off the visible disc during the forecast period. STEREO A EUVI 195 imagery hints that Ex-2891 may lie narrowly over the eastern limb, perhaps impacting on probabilities of flares into the new week, although for now Very Low solar activity is forecast, with a daily slight chance (10%) of C-class flares.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Cylindrical projection of the hole sun in 195 Angstroms, showing a possible returning bright flux region lying over the eastern limb.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16, remained at Background levels during the previous 24 hours, and is currently forecast to remain at this level through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) has been at mainly Moderate levels, but may rise once the (apparent) brake of geomagnetic activity from current CH20/- is released. There is a Chance of 24-hour electron fluence exceeding Active in the period, although confidence in this aspect is relatively low for the lack of a relevant analogue on last rotation.

MOSWOC REFM suggests an increasing risk of breaching Active in the next 72 hours, a proposal that is tentatively accepted, although the chances of this occurring are now felt to be lower than 24 hours ago, now the more muted character of CH20/- is becoming clear. Whatever the attained peak, the risk of further increases in fluence should have passed by day three, Tuesday 23 November.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	40	40	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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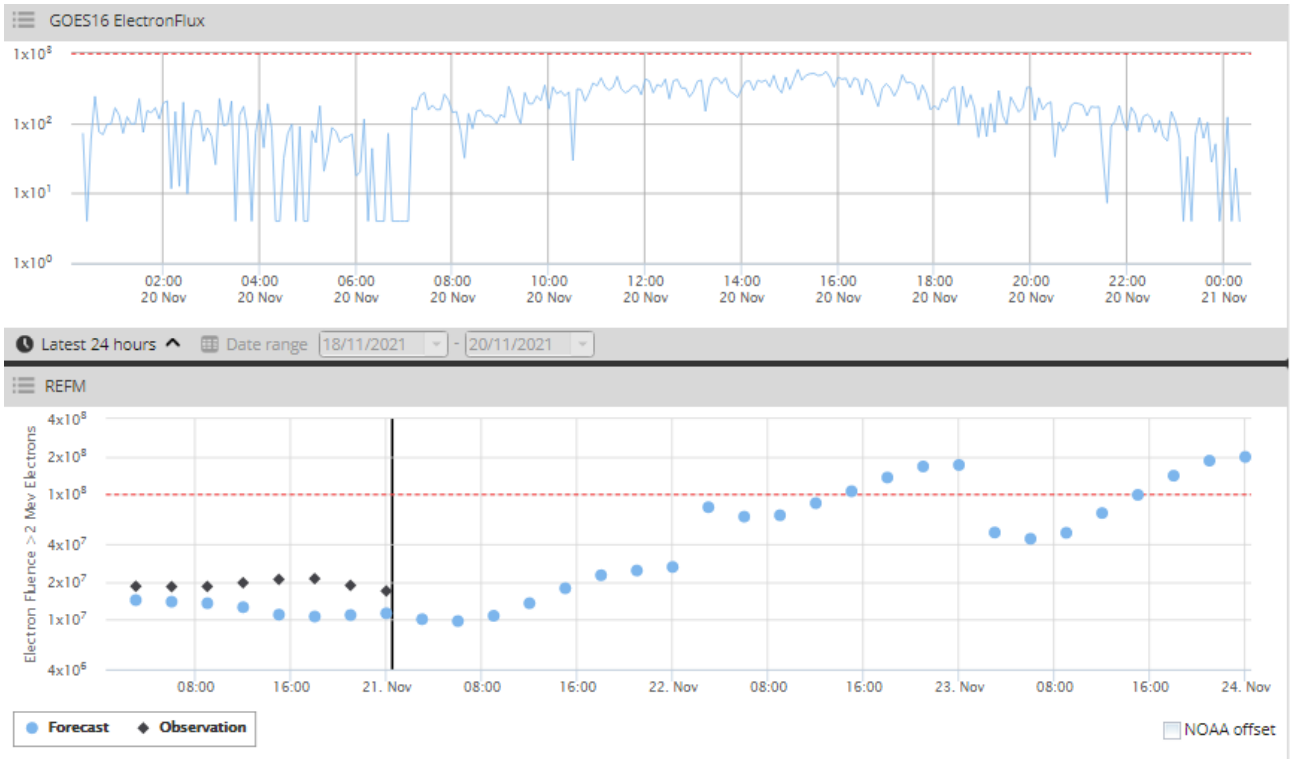
Figure 4: GOES 16 high energy electron flux and latest MOSWOC REFM. The modelled rise in fluence is accepted, although confidence as to the degree which this occurs is low, and recent REFM runs can be seen to be fairly volatile about the Active threshold.



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